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Directly Driven Extruder With an Adapter

The invention relates to an extruder device, as claimed in the preamble of claim 1.

Conventional extruder devices exhibit an extruder worm; and said devices are driven by a worm drive by means of a gear transmission unit. However, such gear transmission units are mechanically complicated and maintenance intensive, so that recently attempts have been made to drive the extruder worms directly—that is, without a gear transmission unit.

With the emergence of the so-called hollow shaft motors, it is now possible to build such directly driven extruder devices with smaller dimensions. Thus, for example, EP 1 182 027 A1 proposes an extrusion device, wherein the extruder worm exhibits a connecting section, which is inserted into a bushing and then is or will be connected to the same so as to be rotationally rigid. Therefore, the connecting section and the bushing are surrounded by the aforesaid hollow shaft motor, which can transfer the drive torque, generated by said motor, to the bushing by means of the torque-transmitting elements. Due to the fact that the hollow shaft motor surrounds the connecting section of the extruder worm, the overall length of the entire extrusion device is relatively short.

However, the drawback with this construction is that the torque-transmitting elements are difficult to access. Hence, the advantage of the somewhat shorter overall length is more than frustrated by longer continual maintenance work.

Therefore, the object of the present invention is to improve a prior art gearless extrusion device in such a manner that the torque-transmitting elements are easier to access.

The problem is solved by the features in the characterizing part of claim 1.

According to said characterizing part, the torque-transmitting elements in the axial direction are located outside the rotor. In this manner the torque-transmitting elements are easy to reach without having to remove the hollow shaft motor with its outer stator and internal rotor. In the language of the present document a connecting section is defined as any continuation or extension of the extruder worm. Therefore, it is irrelevant whether this connecting section is stamped as one piece with the extruder worm or is connected mechanically to the same.

In another design of the invention the torque-transmitting elements are arranged between the extruder worm and the drive motor in order to use an extruder worm with a connecting section that is as short as possible.

It is advantageous if the torque-transmitting elements include a screw connection that runs in the axial direction and with which the bushing and the connecting section can be connected so as to be rotationally rigid. In this case the bushing and the connecting section can be quickly disconnected without any complications. This screw connection can be easily reached through the hollow shaft of the drive motor.

Another advantageous design of the invention provides that at least one of the torque-transmitting elements is at least partially encompassed by a housing, which is rigidly connected to the housing of the extruder worm. Therefore, it is possible to

protect the torque-transmitting elements against external interference factors, such as dust. In addition, this housing can also be attached detachably to the housing of the drive motor with the housing. Then all of the elements of the extruder device form a unit that can then be designed, for example, so as to be moveable.

Furthermore, it is especially advantageous if one of the torque-transmitting elements is braced against the encompassing housing by means of roller bearings and/or ball bearings. Experiments have shown that during operation considerable forces, which must be absorbed with suitable bearings, act on the extruder worm. If conventional hollow shaft motors, the bearings of which are not designed for the forces prevailing in extruders, are used, then frequent bearing damage must be expected. In contrast, a structural adaptation of the hollow shaft motors to the said demands would result in very high costs, for which reason this solution would be disadvantageous.

The roller bearings that are used are advantageously angular contact bearings that are capable of absorbing the axial forces. Furthermore, they are self-centering.

Other embodiments of the invention are disclosed in the dependent claims and the drawings. In the drawings,

Figure 1 shows an extruder device, according to the invention; and
Figure 2 shows an inventive extruder device with a drive motor with a solid shaft;
Figure 3 shows an identical extruder device with an additional sleeve;
Figure 4 shows another embodiment of the extruder device of the invention;
Figure 5 shows another embodiment of the extruder device of the invention.

Figure 1 depicts an inventive extruder device, which comprises a drive motor 1, torque-transmitting elements, all of which are labeled 2, and an extruder 3. The extruder 3 comprises, as

customary in everyday practice, essentially an extruder worm 4, which is mounted rotatably in an extruder housing 5. The motor 1 comprises a stator 7, which is surrounded by a motor housing 12, and a rotor 8, which is braced against the stator 7 by means of the radial bearing 9. The rotor 8 is like a hollow shaft so that it exhibits a tube-shaped interior 11. Furthermore, the rotor 8 includes an extension 10, which projects beyond the stator 7 and is surrounded by a housing extension 13.

To transmit the torque, generated by the drive motor 1, to the extruder worm 4, a bushing 14 is attached on the face side to the extension 10 of the rotor 8. This connection is rotationally rigid and can be made by means of not only a screw connection but also by means of a snap-in connection. This bushing 14 envelops the connecting section 6 of the extruder worm 4. To transmit the torque at the bushing 14 to the extruder worm 4, its connecting section 6 is screwed to the bushing 14 with a screw 15 so as to be rotationally rigid. The rotational rigidity is achieved chiefly by a groove-spring system or an equivalent system between the connecting section 6 and the bushing 14. Of course, a plurality of screws can also be provided. These screws 15 can be easily reached from the side, which belongs to the drive motor 1 and which faces away from the extruder 3, through the tubular interior 11 of said motor. The connecting section 6 is braced against the bushing 14 in the axial direction by way of ring steps, so that the bushing 14 and the connecting section 6 cannot be moved relative to each other in the axial direction. The connection of the bushing 14 and the connecting section 6 can be detached, for example, for maintenance work. As soon as the connection has been detached, the extruder worm 4 can be pulled out of the extruder housing 5 in the direction of the drive motor 6 [sic].

The bushing 14 and the connecting section 6 are encompassed by a housing 16. The various housings 5, 13, 16 and 12 are connected together so that they form a housing unit. The housing 16 envelops a roller bearing 17, against which the bushing 14 is braced in turn. In addition, a ring 18 is fastened to the bushing 14, so that the bushing 14 is positioned in such a manner relative to the housing 16 that said bushing cannot be displaced. At this point it would be worth mentioning

that during operation the pressure, issuing from the extruder worm 4, runs in the axial direction to the drive. Therefore, the roller bearing 17 is capable of absorbing the axial forces occurring at the extruder worm 4.

Figure 2 depicts an embodiment of the invention with a drive motor 1 with a solid shaft, into which a tubular interior 11 was bored. The diameter of said shaft is sufficient to receive the screw 25, which, in contrast to the screw 5, illustrated in Figure 1, is long enough to extend through the drive motor 1. In this embodiment the bushing 14 and the rotor 8 are made as one piece. However, in comparison to the embodiment shown in Figure 1, the function of the individual components is kept.

Figure 3 depicts an embodiment of the present invention that is very similar to the one shown in Figure 1. In this case, an intermediate bushing 21 is fastened inside the bushing 14 so as to be rotationally rigid. At the same time the intermediate bushing 21 can be screwed into the bushing 14 or be connected to the same by means of a groove-spring system. Therefore, the connecting section 6 of the extruder worm 4 is braced against the intermediate bushing 21 by means of the ring steps. In this configuration the extruder worm 4 and the intermediate bushing 21 can be pulled out of the extruder housing 5 through the tubular interior 11 of the drive motor 1. Furthermore, compared to the embodiment presented in Figure 1, the screw 15 has been replaced with a bolt 19. This bolt 19 extends at least through the entire tubular interior of the drive motor 1 and exhibits, analogous to the screw, a thread on one end so that with this bolt 19 a rotationally rigid connection between the connecting section 6 of the extruder worm 4 and the bushing 14 can be made.

The diameter of the end of the bolt 19 that is located opposite the thread can be made smaller. A sleeve 20, which in turn is fastened to the motor housing 12, can be slid on this thinner section. In this way

an abutment is formed, by means of which the bolt 19 can brace the intermediate bushing 21.

Figure 4 depicts an extruder device with an intermediate bushing 21, as shown previously in Figure 3. To prevent the intermediate bushing 21 from moving axially inside the bushing 14, a lock washer 22 is screwed into said bushing.

The extruder device, shown in Figure 5, is similar to the one shown in Figure 1. In this case the connecting section 6 and the bushing 14 are connected together by means of locking pins 24 so as to be twist-proof. Since these locking pins 24 can be moved in the axial direction, they are fixed in position by the lock washer 23, which is fastened, for example screwed, in the bushing 14. Then the connecting section with the bushing can be connected with the screw 15.

List of Reference Numerals

1	drive motor
2	torque-transmitting elements
3	extruder
4	extruder worm
5	extruder housing
6	connecting section
7	stator
8	rotor
9	radial bearing
10	extension
11	tubular interior
12	motor housing
13	housing extension
14	bushing
15	screw
16	housing
17	roller bearing
18	ring
19	bolt
20	sleeve
21	intermediate bushing
22	lock washer
23	lock washer
24	locking pin
25	
26	
27	
28	
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30	